

CE CIT UOB

ITCE471 (DSP)

Quiz 1

Time: 15 minutes

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Q: A system $y[n] - 0.5y[n-1] = x[n]$:

1. Find impulse response
2. Find $y[n]$ if $x[n] = \cos(\pi n)$
3. Find $y[n]$ if $x[n] = \sin(\pi n)$

1.

$$Y(e^{j\omega}) - 0.5 Y(e^{j\omega}) e^{-j\omega} = X(e^{j\omega})$$

$$Y(e^{j\omega}) [1 - 0.5 e^{-j\omega}] = X(e^{j\omega})$$

$$H(e^{j\omega}) = \frac{Y(e^{j\omega})}{X(e^{j\omega})} = \frac{1}{1 - 0.5 e^{-j\omega}}$$

$$(H(e^{j\omega}))^{-1} = \left(\frac{1}{2}\right)^n u[n] \rightarrow h[n] = \left(\frac{1}{2}\right)^n u[n]$$

2. $H(e^{j\omega}) = \frac{2}{2 - e^{-j\omega}} \rightarrow \frac{2}{2 - (\cos\omega - j\sin\omega)}$
 at $\omega = \pi \rightarrow H(e^{j\omega}) = \frac{2}{2 - (-1)} = \frac{2}{3}$

$$y[n] = x[n] \cdot H(e^{j\omega}) \rightarrow y[n] = \cos(\pi n) \cdot \frac{2}{3}$$

$$y[n] = \frac{1}{2} (e^{j\pi n} + e^{-j\pi n}) \left(\frac{2}{3}\right)$$

$$y[n] = \frac{1}{3} e^{j\pi n} + \frac{1}{3} e^{-j\pi n} = \frac{2}{3}$$

3. $y[n] = \sin(\pi n) \cdot \frac{2}{3} \rightarrow y[n] = \frac{1}{2} (e^{j\pi n} - e^{-j\pi n}) \left(\frac{2}{3}\right)$

$$y[n] = \frac{1}{3} e^{j\pi n} - \frac{1}{3} e^{-j\pi n} = 0$$